The Interlayer Collapse during Dehydration of Synthetic $Na_{0.7}$-Beidellite: A ^{23}Na Solid-State Magic-Angle Spinning NMR Study[1]

J. Theo Kloprogge, J. Ben H. Jansen, Roelof D. Schuiling and John W. Geus[2]

Department of Geochemistry, Institute for Earth Sciences, University of Utrecht Budapestlaan 4, P.O. Box 80.021, 3508 TA Utrecht, The Netherlands

[2] Department of Inorganic Chemistry, University of Utrecht P.O. Box 80083, 3508 TB Utrecht, The Netherlands

[1] Publication of the Debye Institute, University of Utrecht, The Netherlands.

Abstract: The dehydration and migration of the interlayer cation of the synthetic beidellite $Na_{0.7}Al_{4.7}Si_{7.3}O_{20}$-$(OH)_4$·$nH_2O$, were studied with solid-state ^{23}Na and ^{27}Al MAS-NMR, heating stage XRD, and thermogravimetric analyses (TGA, DTA). The ^{23}Na MAS-NMR of Na-beidellite at 25°C displays a chemical shift of 0.2 ppm, which indicates a configuration comparable with that of Na^+ in solution. Total dehydration proceeds reversibly in two temperature ranges. Four water molecules per Na^+ are gradually removed from 25° to 85°C. As a result, the basal spacing decreases from 12.54 Å to 9.98 Å and the Na^+ surrounded by the two remaining water molecules is relocated in the hexagonal cavities of the tetrahedral sheet. The chemical shift of 1.5 ppm exhibited after the first dehydration stage illustrates the increased influence of the tetrahedral sheet. The high local symmetry is maintained throughout the entire first dehydration stage. During the second dehydration, which proceeds in a narrow temperature range around 400°C, the remaining two water molecules are removed reversibly without any change of the basal spacing.

Key Words: Beidellite • Dehydration • Interlayer collapse • ^{23}Na MAS-NMR

Clays and Clay Minerals; October 1992 v. 40; no. 5; p. 561-566; DOI: 10.1346/CCMN.1992.0400510

Clay Minerals Society (www.clays.org)